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(54) **Glass fiber insulation and process.**

(57) There is disclosed glass fiber particularly useful for preparing formed insulating articles having on the surface of the fibers an amorphous aluminum phosphate polymer wherein the polymer resiliently tacks the glass fibers together so as to provide regain of shape after deformation of the fibers as by compression. Also disclosed is a process for preparing glass fiber articles wherein the fibers are contacted with an ionic polymer which is then dehydrated to form an amorphous non-hygroscopic polymer.

EP 0 539 342 A1

Exhibit A



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### T 0402/98 - 3.3.5

PDF	Case number	Date	Application number	Title	IPC
	T 0402/98 3.3.5	09 November 2001	92870157.2	Glass fiber insulation and process	<u>C03C25/C</u>

#### Keywords

Novelty (yes) - inevitable result (not shown)  
Inventive step (confirmed)


### T 0529/98 - 3.3.5

PDF	Case number	Date	Application number	Title	IPC
	T 0529/98 3.3.5	21 November 2001	93902010.3	Production of hydrogen Peroxide	<u>C01B15/C</u>

#### Keywords

Clarity (no)


### T 0608/98 - 3.2.3

PDF	Case number	Date	Application number	Title	IPC
	T 0608/98 3.2.3	08 November 2001	91301594.7	Lens edging system	<u>B24B9/14</u> <u>B24B13/0</u> <u>B24B49/0</u>

#### Keywords

-

### T 0609/98 - 3.2.5

PDF	Case number	Date	Application number	Title	IPC
	T 0609/98 3.2.5	26 November 2001	92300009.5	Paint roller and method and apparatus of manufacturing a paint roller	<u>B29C63/1</u>

#### Keywords

Novelty (yes)  
Inventive step (yes)  
Different apportionment of costs (no)

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**D E C I S I O N**  
**of 9 November 2001**

**Case Number:** T 0402/98 - 3.3.5

**Application Number:** 92870157.2

**Publication Number:** 0539342

**IPC:** C03C 25/02

**Language of the proceedings:** EN

**Title of invention:**  
Glass fiber insulation and process

**Patentee:**  
ASTARIS LLC

**Opponent:**  
ROCKWOOL International A/S  
Deutsche Rockwool Mineralwoll-GmbH

**Headword:**  
Glass fibres/ASTARIS

**Relevant legal provisions:**  
EPC Art. 54, 56, 100(b)

**Keyword:**  
"Novelty (yes) - inevitable result (not shown)"  
"Inventive step (confirmed)"

**Decisions cited:**  
-

**Catchword:**  
-



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Boards of Appeal

Chambres de recours

Case Number: T 0402/98 - 3:3.5

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.5  
of 9 November 2001

**Appellant:**  
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**Respondent:**  
(Proprietor of the patent)

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**Decision under appeal:**

Interlocutory decision of the Opposition Division  
of the European Patent Office posted 23 February  
1998 concerning maintenance of European patent  
No. 0 539 342 in amended form.

**Composition of the Board:**

**Chairman:** R. K. Spangenberg

**Members:** M. M. Eberhard

M. B. Guenzel

## Summary of Facts and Submissions

I. European patent No.0 539 342 was granted on the basis of 17 claims. Opponents I and II filed notices of opposition requesting revocation of the patent on the ground of lack of novelty (Opponent I) and lack of inventive step. They relied on EP-A-0 503 555 (D1), US-A-2 444 347 (D2), US-A-2 405 884 (D3), US-A3-150 034 (D4), CH-C-355 825 (D5), GB-A-2 093 014 (D6) and US-A-2 702 068 (D7).

II. The opposition division decided at the oral proceedings on 28 January 1998 that the patent in amended form with claims 1 to 15 filed during the oral proceedings as the first auxiliary request met the requirements of the EPC. Independent claims 1, 5, 12 and 15 of this request as attached to the minutes of the oral proceedings read as follows:

"1. A composition of matter comprising glass fiber having on its surface a coating consisting essentially of a water insoluble, non-hygroscopic, amorphous aluminum phosphate polymer having a molar ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of less than 1."

"5. A composition comprising a loose mass of glass fibers having on at least a portion of the surface a coating consisting essentially of a water insoluble, non-hygroscopic, amorphous aluminum phosphate polymer having a molar ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of less than 1."

"12. A process for preparing a form retaining insulating body of glass fibers comprising applying to the fibers a tacking agent consisting essentially of an aqueous acid aluminum phosphate solution containing a

molar ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  to  $\text{H}_2\text{O}$  ratio as in the shaded area shown in Figure 1, excluded compositions corresponding to line A (molar ratio of 1:1), shaping said body and then removing water from said tacking agent to form a water-insoluble, non-hygroscopic amorphous polymer whereby the glass fibers of the body are resiliently bonded together."

"15. A process for preparing a loose mass of glass fibers which comprises applying to the fibers a tacking agent comprising an aqueous acid aluminum phosphate solution containing a molar ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of from 1:2 to 1:4, and then removing water to form a water-insoluble, non-hygroscopic amorphous polymer."

In its interlocutory decision, the opposition division took the view that D2 represented the closest prior art. Even if the skilled person had consulted D5, which concerned a different technical field, he would not have derived therefrom a suggestion towards the claimed compositions since D5 taught that the advantages disclosed therein depended on the presence of fillers. There was no incentive in D4 to apply a binder for a wallboard containing asbestos fibres onto glass fibres. Furthermore, D2 did not disclose the temperature necessary to convert the phosphate binder into an amorphous polymer. Neither D6 nor D7 gave a suggestion towards water-insoluble, non-hygroscopic, amorphous aluminium phosphate bonding agents for glass fibres.

- III. The appellant (opponent I) lodged an appeal against this decision and cited two additional documents in the grounds of appeal, namely a commercial leaflet from Guilini Chemie GmbH about ALUPHOS, AMBIX, ALUPHOS modified, PHOSTRA 10, AGILU 70, october 1976

(hereinafter D8), and Journal of the American Ceramic Society, vol. 33, No. 8, August 1950, pages 242 to 247 (D9). In a communication from the board, the question was raised whether or not the claimed subject-matter meets the requirement of novelty with respect to D1 or D5. Oral proceedings were held on 9 November 2001. The appellant had informed the board by a letter dated 30 August 2001 that he did not intend to attend the oral proceedings and was, accordingly, not present.

IV. The appellant's arguments can be summarised as follows:

The subject-matter of claim 1 lacked an inventive step. D8 suggested that the problem encountered with organic binders could be solved by using aluminium phosphate bonding agents, in particular pure ALUPHOS which had a molar ratio  $\text{Al}_2\text{O}_3/\text{P}_2\text{O}_5$  within the range 1:2.9 to 1:3.2. D5 concerned the same technical field as the patent in suit. Claim 1 was directed to products comprising coated fibres and did not even refer to a binding agent. The product of D5 comprised fibres embedded in a material partly consisting of the same coating agent as the claimed one. The skilled person would have consulted D5 since the quality of both a laminated fibrous product and a bonded fibrous insulation product depended on the strength with which the fibres were bonded together. D5 taught that the products had excellent properties including electrically insulating properties. According to D7 a heat treatment at a temperature of up to 500°C resulted in the formation of aluminium polyphosphate which, being a polymer, was amorphous, cf D8. Thus, the combination of the teachings of D5 and D7 suggested that the problems associated with the known organic coating agents could be solved by applying to the glass fibres a coating



agent/binder consisting of an aqueous solution of an aluminium phosphate with a molar ratio  $\text{Al}_2\text{O}_3/\text{P}_2\text{O}_5$  of about 1/3 and heating the treated fibres to a temperature within 200 to 500°C to form an aluminium phosphate polymer coating and that such a coating would maintain its binding ability at elevated temperatures or turn into a ceramic bond. The statement in D5 that the structural elements were water-sensitive in the absence of a filler would have been disregarded by the skilled person. It was unlikely that the different substances of the large group of inorganic fillers were all capable of reacting with the mixture of aluminium phosphate and phosphoric acid so as to form a water-insensitive reaction product. Furthermore if this statement were considered in the light of D7 according to which a heat treatment of ALUPHOS might turn into a ceramic bond, it would not have discouraged the skilled person from using an ALUPHOS bonding agent for the coating/bonding of glass fibres. The subject-matter of claim 5 was also obvious since the provision of loose fibre containing a binder was well-known.

If the statement in D5 were to be taken seriously, it would raise the question whether the patent in suit disclosed the steps necessary to obtain a water-insoluble, non-hygroscopic aluminium phosphate polymer.

- V. Concerning the issue of novelty, the respondent argued that the heating conditions indicated in the patent in suit were critical and necessary to obtain a polymer having the claimed properties. D1 did not indicate any time for the heating step. Therefore the teaching of D1 would not necessarily lead to an amorphous, non-hygroscopic, water-insoluble polymer. D5 did not clearly define the final product and disclosed

conditions for the heating step which differed from those stated in the patent in suit. The expression "consisting essentially of" excluded the presence of 10 wt% filler since the highest amount of additive in the patent in suit was 0.5 wt%. Regarding inventive step, the respondent argued that D8 actually related to refractory compositions. Effective ALUPHOS cold bonding required up to 10% of bond clay to be included with the ALUPHOS. The latter reacted with the components of the refractory composition to thus generate a continuous phase. While the initial molar ratio  $\text{Al}_2\text{O}_3/\text{P}_2\text{O}_5$  in D8 could be 1/3, the reaction needed to produce the bonds modified this ratio in a manner to exclude the formation of amorphous, water insoluble, non-hygroscopic coatings. D9 was not more relevant either. It related to cold-setting bonds in refractory applications. Even if the skilled person had used the amorphous polymer disclosed in D9 for coating glass fibres, he would not have arrived at the claimed invention since the heating conditions necessary to obtain the claimed products were neither disclosed in D2 nor in D5 or D9. D5 taught that in the absence of the filler the coating became hygroscopic and would be destroyed. In D7 the heat treatment was carried out at temperatures far too low to yield a coating as defined in the present claims. In addition, the reaction between the aluminium phosphate solution and the asbestos product was such that the majority of the phosphate ions were no longer available for the formation of an amorphous material. Therefore the combined teachings of D5 and D7 could not have led in an obvious manner to the claimed product. The statement in D5 about the water-sensitivity of the product in the absence of filler would have discouraged the skilled person from using ALUPHOS for coating glass fibres even

in view of the teaching of D7 and D8. The respondent contested the appellant's argument that the patent in suit did not disclose the steps necessary to obtain a water-insoluble, non-hygrosopic polymer.

- VI. The appellant requested in writing that the decision under appeal be set aside and that the patent be revoked. The respondent requested that the appeal be dismissed.

### **Reasons for the Decision**

1. The appeal is admissible.
2. The board observes that claims 1 to 17 according to the first auxiliary request annexed to the written decision of the opposition division are not identical with claims 1 to 17 of the first auxiliary request attached to the minutes of the oral proceedings before the opposition division (see in particular claims 12 and 15). It clearly derives from the said minutes that the decision announced orally by the opposition division was based on claims 1 to 17 of the first auxiliary request submitted on 28 January 1998 which are annexed to the minutes. The present decision from the board is also based on claims 1 to 17 according to the first auxiliary request filed on 28 January 1998 and attached to minutes of the oral proceedings before the opposition division.
3. The amended claims meet the requirements of Articles 123(2) and (3) EPC. In particular, it is directly and unambiguously derivable from the

application as filed that the glass fibres have on their surface a coating consisting essentially of a water insoluble, non-hygroscopic, amorphous aluminium phosphate polymer having a ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of less than 1 : see original claim 1; page 1, first paragraph; page 4, lines 29 to 32; page 5, lines 15 to 17; page 7, lines 23 to 30, and the examples. The scope of protection of the amended claims is restricted with respect to that of the granted claims. The expression "a coating consisting essentially of" used in amended claim 1 excludes the presence of an important amount of components other than the polymer in the coating contrary to the expression "containing on its surface" indicated in granted claim 1. The replacement of the terms "a tacking agent comprising" used in granted process claim 12 by "a tacking agent consisting essentially of" represents a limitation of the scope of protection, as well as the addition of the features "water-insoluble, non-hygroscopic" in claims 12 and 15.

4. D1 is a prior art document as defined in Article 54(3) and (4) EPC only for the parts of D1 which are entitled to the priority date of 13 March 1991. D1 discloses a mineral wool product which is treated with an aqueous dispersion containing aluminium metaphosphate (ie  $\text{Al}(\text{PO}_3)_3$ ) as the binder, ie a starting aluminium phosphate having a ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of less than 1. The mineral wool is then heat treated at temperatures between  $250^\circ\text{C}$  and  $500^\circ\text{C}$ , preferably  $275^\circ\text{C}$  to  $350^\circ\text{C}$  to remove the humidity still present and also the organic material. This leads to the formation of the desired phosphate glass bond with the mineral fibres (see claim 1, and column 5, lines 10 to 19). It is not contested that this disclosure has the valid priority date of 13 March 1991.

D1 is silent about the properties of the resulting phosphate glass, ie its water solubility and hygroscopicity. As pointed out by the respondent at the oral proceedings, the patent in suit discloses that the removal of water which is carried out by heating the coated fibres under certain conditions is critical to the obtention of a polymer having the desired properties, ie a water-insoluble, non-hygroscopic amorphous polymer. According to the patent in suit, it is important to control the removal of water. If it is insufficient, the residue may be hygroscopic. If the removal of water is accompanied by excessive heat and water removal an undesired crystalline aluminium phosphate is produced. In either of both cases the desired amorphous polymer is not formed in sufficient amounts to impart the desired properties in the glass fibre article. The desired water insoluble amorphous polymer is formed by heating the treated glass fibre in the range of about 350°C to about 400°C for about 45 to about 90 seconds (see page 4, lines 2 to 12). As, on the one hand, D1 neither discloses the properties of the resulting glassy phosphate nor the period of time used for the heat treatment, and, on the other hand, the appellant has provided no evidence that the heat treatment of D1 would inevitably lead to the formation of a water insoluble, non-hygroscopic aluminium phosphate polymer although the burden of proof rests with him, the board considers that it has not been shown that D1 destroys the novelty of the products and processes as claimed in claims 1, 5, 12 and 15.

- 4.1 Turning to the novelty issue with respect to D5, the question was raised whether or not the expression "consisting essentially of" indicated in present claims 1 and 5 excludes the presence of 10 wt% of

filler which is disclosed in dependent claim 1 of D5. In the board's view this question may remain open since novelty of the claimed products can be acknowledged with respect to D5 for the following reasons. D5 discloses impregnating the fibrous material (glass fabrics, papers or mats; asbestos fabrics, papers or mats; quartz mats and mixtures of at least two inorganic fibres) with an aqueous suspension containing aluminium phosphate, phosphoric acid and a solid fine mineral filler. The aluminium phosphate may be the orthophosphate  $\text{AlPO}_4$ , monoaluminium phosphate  $\text{Al}(\text{H}_2\text{PO}_4)_3$ , and dialuminium phosphate  $\text{Al}_2(\text{HPO}_4)_3$  (see claim I and dependent claims 1 to 4; column 2, lines 86 to 90). According to one embodiment of D5, the process comprises drying the impregnated fibrous material (for example the impregnated glass fabric), disposing several sheets of the impregnated fabric on each other, pressing at a temperature of 40 to 100°C and heat treating the pressed product in an oven at a temperature of preferably 200 to 500°C for several minutes to several hours to completely cure the product (see page 1, right-hand column). In Example 1, in which a glass fabric is impregnated with an aqueous suspension containing 10 parts of aluminium orthophosphate (ie  $\text{Al/P} = 1$ ), 10 parts orthophosphoric acid and 50 parts calcium silicate as the filler, the plate is cured in an oven whose temperature is gradually raised to 250°C and maintained at this temperature for 30 minutes. In Example 2 where asbestos paper is impregnated with a suspension containing 60% of filler, the product is cured at 285°C for 3 hours. D5 does not disclose that the cured product contains a water-insoluble, non-hygroscopic, amorphous aluminium phosphate polymer. The heat treatment conditions disclosed in D5 differ from those indicated in the

patent in suit for obtaining a water insoluble, non-hygroscopic, amorphous aluminium phosphate polymer and considered to be important and critical (see point 4 above). The appellant has not shown that the conditions disclosed in D5 for the heat treatment would inevitably lead to glass fibres having a coating as defined in claims 1, 5, 12 and 15. Therefore, the subject-matter of these claims is novel with respect to D5.

- 4.2 The claimed subject-matter is also new over the disclosure of the other documents cited during the opposition and the appeal proceedings. This was not disputed by the appellant.
5. The parties and the opposition division considered that D2 represented the closest prior art. Taking into account that D2 concerns glass fibre articles in which the binder in the coating composition is basically an aluminium phosphate and that D2, like the patent in suit, deals with the environmental problem resulting from the use of synthetic organic binders for bonding glass fibres, the board considers D2 as an appropriate starting point for assessing inventive step.
- 5.1 D2 discloses a composition of matter comprising glass wool fibres bonded together with an aluminium phosphate binder. The composition may comprise a loose mass of glass fibres coated and agglutinated with the said binder. The products of D2 are prepared by applying a binder of aluminium phosphate base to the glass wool or fibres and drying the binder. Heat and pressure may be employed to effect moulding of the glass fibres or glass wool after the binder has been applied thereto. The composition of the aluminium phosphate may vary from the monoaluminium phosphate  $\text{Al}(\text{H}_2\text{PO}_4)_3$  to the

dialuminium phosphate  $\text{Al}_2(\text{HPO}_4)_3$ . For loose wool the aluminium phosphate used ranged between the monoaluminium phosphate and that having an  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of 1.25:3. The use of the said aluminium phosphates as an agglutinant provides many advantages which are not possible with the synthetic organic resins. The latter have the drawbacks of charring with the evolution of obnoxious odours when raised to decomposition temperatures and at the same time they lose their bonding properties (see claims 1 to 6 and 9 to 13; column 1, lines 27 to 33 and 40 to 53; column 3, lines 8 to 12 and 40 to 56; column 4, lines 7 to 11 and 54 to 56).

- 5.2 Starting from D2 as the closest prior art, the technical problem underlying the claimed subject-matter can be seen in providing glass fibre articles suitable for insulating purposes and having in particular an adequate resilience while (like in D2) avoiding the drawback resulting from the use of organic resin binders.

It is proposed to solve this problem by the products as defined in amended claims 1 and 5 and the processes according to claims 12 and 15. The claimed products differ from those of D2 in that the coating on the surface of the fibres consists essentially of a water insoluble, non-hygroscopic, amorphous aluminium phosphate polymer having a mole ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of less than 1. The processes of claim 12 and 15 differ from the process of D2 by the step of removal of the water being performed so as to form a water-insoluble, non-hygroscopic, amorphous polymer. In view of the disclosure in the patent in suit it is credible that the technical problem stated above has actually been



solved by the claimed products and processes. In particular the examples and comparative examples of the patent in suit show that the claimed products, which contain the specific polymer defined in the claims instead of an organic resin as the binder, have in particular a resilience comparable to that of insulating articles containing an organic resin.

- 5.3 According to D2, drying is effected after application of the colloidal phosphate binder to the glass fibre or wool bodies. In the case where the fibres are moulded to different shapes heat and pressure is applied to the glass fibres coated with the binder (see column 4, lines 35 to 49). Neither the drying temperature nor the temperature used during the moulding step are disclosed in D2. As indicated above in point 3, according to the patent in suit the step of removal of water is critical to obtain the desired water-insoluble, non-hygroscopic, amorphous polymer and the latter is formed by heating the treated fibres to a temperature in the range of from about 350 to 400°C for about 45 to 90 seconds. The disclosure of a drying step or of the application of heat during the moulding step does not suggest the critical conditions indicated above. Furthermore D2 is silent as to the properties of the final coating. It does not teach nor suggest that the temperature during the drying step or the moulding step should be such that the colloidal aluminium phosphate agglutinant or binder be converted to a water-insoluble, non-hygroscopic, amorphous polymer. D2 further discloses that the aluminium phosphate binder may be made in accordance with the disclosures in D3 (see column 4, lines 27 to 29). However, D3 discloses no additional information from which the skilled person would have inferred that the products of D2 were dried or moulded

under such conditions that the colloidal aluminium phosphates are converted to a water-insoluble, non-hygroscopic, amorphous polymer.

- 5.4 In the process for preparing the construction elements of D5, the heating step is performed under conditions which differ from those indicated in the patent in suit (see point 4.1 above). D5 does not suggest that the final product contains a water-insoluble, non-hygroscopic amorphous aluminium phosphate polymer after the heating step. The presence of an inorganic filler is mandatory and the two examples contain 50 and 60 wt% thereof. D5 teaches that in the absence of the inorganic filler the construction elements are sensitive to the humidity and absorb water, which leads to the destruction of the bond between the layers of fibrous material and in most cases to the complete destruction of the insulating properties (see page 2, lines 56 to 63). This teaching would not give the skilled person an incentive to leave out a major part of the inorganic filler and to modify the heat treatment of the coated fibres so that the aluminium phosphate is converted to a water-insoluble, non-hygroscopic, amorphous polymer as defined in the present claims in order to obtain a glass fibre insulation having in particular the required resiliency. The appellant's arguments that the skilled person would have disregarded the said statement on page 2 of D5 is not convincing since it is based on the unproven assumption that the inorganic fillers listed in D5 were not all capable of giving a water-insensitive product by reaction with the mixture of aluminium phosphate and phosphoric acid. Furthermore, even if the skilled person had disregarded this statement, he would not have arrived in an obvious

manner at the claimed subject-matter by combining the teachings of D2, D3 or D5 since none of them suggests that the glass fibres coated with the aluminium phosphate composition should be converted to the water-insoluble, non-hygroscopic, amorphous polymer as defined in the present claims in order to solve the problem stated above. These documents accordingly contain no information as to how the heat treatment for the water removal should be performed to obtain the said polymer.

- 5.5 The appellant argued in the grounds of appeal that according to D7 a heat treatment at a temperature of up to 500°C resulted in the formation of aluminium polyphosphate which, being a polymer, was amorphous. The board observes that D7 does not relate to glass fibres coated with an aluminium phosphate as the binder but to aluminium phosphate-bonded **asbestos** insulating material. The asbestos sheets may contain only minor amounts of bentonite or glass fibers (see column 1, lines 15 to 18; column 2, lines 12 to 15). Furthermore D7 does not disclose the treatment of the asbestos sheet impregnated with monoaluminium phosphate at a temperature of up to 500°C nor the formation of an amorphous aluminium polyphosphate. The highest temperature disclosed in D7 for the heating step is 250°C (see column 3, lines 1 to 11). Therefore the appellant's arguments concerning the lack of inventive step based on the combination of D5 and D7 cannot be accepted. The board observes in this context that the question from the board whether the reference to D7 in the grounds of appeal was correct or should be replaced by a reference to D8 or D9 remained without reply. D7 in fact contains no information from which it could be inferred that a water-insoluble, non-hygroscopic

amorphous polymer having a  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  ratio of less than 1 is present in the final product.

- 5.6 As pointed out by the appellant D8 discloses that the problem encountered with organic binders could be solved by using an aluminium phosphate bonding agent such as ALUPHOS, which is a highly concentrated, acid solution containing 50% of mono-aluminium phosphate, the molar ratio  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  being adjusted to 1 to 2.9 to 3.2. However, D8 does not disclose the use of ALUPHOS as a bonding agent for glass fibres but for refractory products having an  $\text{Al}_2\text{O}_3$  content of 60-90% such as corundum, mullite and sintered bauxite. It further teaches that ALUPHOS produces a very good bond with fire clay, silicon carbide, chromite, and within certain limitations with quartz. According to D8, the binding process is based on the reaction of ALUPHOS with weak basic oxides (e.g. alumina) resulting firstly in the formation of orthophosphates. Bond clay has therefore to be added to  $\text{Al}_2\text{O}_3$ -free masses. The binding process with ALUPHOS in the ceramic mass is accelerated by heating so that, in practice, the refractory products to be bound are heated to 120°C to 200°C (see page 3, left-hand column, "Binding Process"; right-hand column second paragraph). D8 further discloses the results of the thermogravimetric analysis of pure ALUPHOS which is said to show that several water containing crystalline phases are formed at temperatures below 200°C. At higher temperatures of 300°C to 600°C lower molecular acid aluminium polyphosphates are produced. Increasing the temperature further leads to higher molecular Al metaphosphates  $\text{Al}(\text{PO}_3)_3$  (see page 2, lines 7 to 15; page 3, left-hand column, first and second paragraph). D8 is completely silent about the properties of the said polyphosphates.

Thus, the skilled person faced with the problem of producing insulating glass fibre articles having in particular the adequate resilience while avoiding the drawbacks of organic resins would not have inferred from this teaching that ALUPHOS has to be converted to a water-insoluble, non-hygroscopic, amorphous polymer as defined in the present claims when applied to glass fibres in order to solve the said problem. Furthermore, neither the heat treatment at a temperature of 120°C to 200°C recommended in D8 to obtain a bond with the refractory material nor the temperature range of 300-600°C which is said to produce lower molecular acid aluminium polyphosphates whose properties are not disclosed suggest the heating conditions stated in the patent in suit for obtaining a water-insoluble, non-hygroscopic amorphous polymer with an  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  of less than 1. Therefore the teaching of D8, even when taken in combination with the disclosures in D2, D3, D5 and D7, could not hint at the claimed solution.

- 5.7 The appellant referred to D9 as relevant prior art in the grounds of appeal and cited the passage on page 245, left-hand column, last paragraph. However in point 5 of the grounds of appeal which relates to inventive step, D9 is not relied upon; the appellant based his arguments only on the combination of D5, D7 and D8. Assuming that the reference to D7 might be erroneous and that a reference to D9 might have been intended, the board has examined whether the teaching of D9, in particular the passage cited by the appellant, would render the claimed subject-matter obvious in combination with the preceding documents. D9 discloses that cold-setting bonds may be formed from certain acid phosphates, for example from monoaluminium phosphate. The effect of temperature on bond strength

was determined for a mortar consisting of fused alumina and 7.15% light English ball clay bonded with 7.15% monoaluminium phosphate (see page 243, right-hand column, last paragraph). The use of this aluminium phosphate for bonding or coating glass fibres is, however, not disclosed in D9. In the passage on page 245 cited by the appellant, it is not disclosed, contrary to the appellant's affirmation, that "heating of  $(\text{Al}_2\text{O}_3 \cdot 3\text{P}_2\text{O}_5 \cdot 3\text{H}_2\text{O})$  to a temperature of up to  $500^\circ\text{C}$  results in the formation of an essentially amorphous product". According to this passage, Figure 7 shows that an essentially amorphous product is formed by loss of combined water; this material partially crystallizes and then forms aluminium metaphosphate at a temperature of  $500^\circ\text{C}$ . It is further explained on page 246 that the thermal effects on monoaluminium phosphate  $(\text{Al}_2\text{O}_3 \cdot 3\text{P}_2\text{O}_5 \cdot 6\text{H}_2\text{O})$  consist of a number of steps, the first step being the loss of combined water that results in the formation of an amorphous compound of the composition  $(\text{Al}_2\text{O}_3 \cdot 3\text{P}_2\text{O}_5 \cdot 3\text{H}_2\text{O})$ . This material crystallises over a fairly wide temperature range, and additional combined water is lost with the formation of aluminium metaphosphate. Crystalline aluminium metaphosphate continues to form and grow over a wide temperature range (see page 245, left-hand column, last paragraph; Figures 6 and 7; page 246, paragraph headed "Effects of Temperature"). The X-ray diffraction pattern (Figure 7) shows an essentially amorphous product at a temperature of  $240^\circ\text{C}$ , a partial crystallisation at  $260^\circ\text{C}$  and a well-crystallised product at  $500^\circ\text{C}$ . D9 is silent about the properties of the amorphous compound produced at temperatures between  $200^\circ\text{C}$  and  $240^\circ\text{C}$ . In any case the conditions at which the amorphous compound was obtained in D9 differ from those considered as critical in the patent in suit for

obtaining a water-insoluble, non-hygroscopic polymer on the surface of the glass fibres. D9 contains no information suggesting that a glass fibre insulation having in particular the adequate resiliency might be obtained by removing the water from the monoaluminium phosphate under such conditions that a water-insoluble, non-hygroscopic, amorphous polymer is formed. Therefore, the teaching of D9 even taken in combination with the disclosures in D2, D3, D5, D7 and D8 would not render the claimed subject-matter obvious.

- 5.8 The appellant did not rely on the remaining documents D3, D4 and D6 at the appeal stage. The board has checked that they contain no information which, in combination with the teaching of the preceding documents would point towards the claimed subject-matter.
- 5.9 It follows from the above that claims 1 and 5 meet the requirement of inventive step set out in Articles 52(1) and 56 EPC. As both independent process claims 12 and 15 comprise the step of removing water from the aqueous acid aluminum phosphate having the molar ratio of  $\text{Al}_2\text{O}_3$  to  $\text{P}_2\text{O}_5$  defined in these claims so as to form a water-insoluble, non-hygroscopic amorphous polymer, the preceding considerations in connection with the product claims apply mutatis mutandis to these claims.

Claims 1, 5, 12 and 15 being allowable, the same applies to dependent claims 2 to 4, 6 to 11, 13, 14, 16 and 17 whose patentability is supported by that of claims 1, 5, 12 and 15.

6. The appellant further argued that the statement in D5 about the water-sensitivity in the absence of a filler

raised the question whether the patent in suit disclosed the steps necessary to obtain a water-insoluble, non-hygroscopic aluminium phosphate polymer. According to the appellant, if this statement were taken seriously, then heating of an aluminium phosphate solution as defined in the patent in suit to a temperature of between 200°C to 500°C would not necessarily result in a water-insoluble and non-hygroscopic product. The legal basis for this objection seems to be a lack of sufficiency of disclosure according to Article 100(b), ie a new ground of opposition. However, the respondent refuted the appellant's arguments and made reference in particular to the heating conditions disclosed in the patent in suit for producing a water-insoluble, non-hygroscopic, amorphous polymer.

The board cannot accept the appellant's arguments for the following reasons. As already indicated above (see point 4.1), the conditions disclosed in the patent in suit for removing the water from the acid aluminium phosphate applied to the glass fibres differ from those disclosed in D5 since removal of water is performed at a temperature in the range of from about 350 to 400°C for about 45 to about 90 seconds in the patent in suit whereas D5 discloses heat treating the pressed product at a temperature of 200 to 500°C for several minutes to several hours. In view of these different conditions, the disclosure of D5 regarding the water-sensitivity of the resulting product is not contradictory to the teaching of the patent in suit according to which a water-insoluble, non-hygroscopic, amorphous polymer is obtained. Furthermore, although the appellant has the burden of proof in this respect, he has provided no evidence showing that the conditions disclosed in the



patent in suit did not result in a water-insoluble, non-hygrosopic, amorphous aluminium phosphate polymer. Therefore, the board considers that the patent in suit also meets the requirement of sufficiency of disclosure.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

U. Bultmann

R. Spangenberg